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PEANUT OIL.

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INTRODUCTION.

A large increase in the acreage of peanuts in the South, especially in the territory infested with the cotton boll weevil, has led owners of oil mills, farmers, merchants, and bankers to look for a new outlet for a part, at least, of the peanut crop. As a result there has arisen during recent years considerable interest in the experimental manufacture of peanut oil in the United States, although up to 1915 little commercial oil was produced; this in spite of the fact that large quantities of peanut oil are imported. Taking the two factors into consideration, namely, an increasing production of peanuts in this country and a considerable import trade in peanut oil, it would seem desirable, if profitable, to convert a portion, at least, of the surplus peanuts into peanut oil and its by-products.

NOTE.—This bulletin will be of interest to owners and managers of oil mills, oil dealers, and business men, and to farmers who are growing or who contemplate growing peanuts.

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Peanut oil is one of the most important of the world's food oils, as is evidenced by the fact that in 1912 over 120,000 metric tons of peanuts in the shell, together with about 240,000 metric tons of shelled nuts, were crushed in Marseille, yielding 15,500,000 gallons of edible oil. In addition to this, about 23,000,000 gallons of inedible peanut oil were produced The same year, Germany imported 68,765 tons of peanuts, practically all of which were used for making oil.

The imports of peanut oil entered for consumption in the United States for the year ended June 30, 1914, amounted to 1,332,108 gallons, valued at $915,939. Almost exactly one-half of this oil was imported through the port of Chicago, which would indicate that a large portion of it was used in the manufacture of oleomargarine.

THE MANUFACTURE OF PEANUT OIL IN EUROPE.

Before discussing the manufacture of peanut oil in the United States a brief description of the raw materials and processes in use abroad may be of interest.

There are at least 10 geographically different varieties of peanuts quoted on the Marseille market. Those from the French colonies of West Africa (Gambia, Rufisque, Kasamanze, Rio Nuez, and Bissagos) are usually imported in the shells, while the shelled nuts come from China, Mozambique, Bombay, and the Coromandel Coast of India. Peanuts in the shell from Rufisque, Soloum, Sina, and Gambia contain from 35 to 36 per cent of oil and yield on a large scale from 28 to 30 per cent of shells and 31½ to 32½ per cent of oil. Figured on the basis of shelled nuts the oil yield is 44 to 45 per cent. The cake usually retains from 8 to 9 per cent of oil. Kasamanze nuts yield 30½ to 31½ per cent of oil. The decorticated Bombay and Coromandel nuts yield 36 to 38 per cent, while those from Mozambique on a practical scale yield 40 to 42 per cent.

The best grades of oil are, of course, made from stock shipped in the shells, as with these there is less opportunity for spoilage during the ocean voyage than with the shelled nuts. The Chinese nuts, which are shelled almost entirely by hand and carefully protected from water or crushing, give a better grade of oil than that obtained from some of the unshelled nuts. Peanuts from India, especially those from the Coromandel Coast, are at present largely shelled by the native method of wetting them down with water so that they open of their own accord, when they are flayed out with clubs. These nuts are not allowed to dry thoroughly before being shipped and consequently undergo heating in transit to Europe, so that as a rule they can not be used for the production of good edible oils, but are worked up for soap stock. The Coromandel nuts are practically all used in this way.

Abroad, almost invariably peanut oil is made from shelled nuts. Mills that buy the nuts in the shells must first shell them by machinery designed particularly for that purpose. The foreign matter, such as sticks and stones, and a small quantity of unshelled peanuts are next removed by running the shelled stock over screens similar to the shakers used in the cotton-oil mills. Then the inner or red skins are removed as completely as possible. These skins, which, strange to say, contain about 14 per cent of oil, are usually saved, added to the refuse meat, and expressed with it, yielding a small quantity of inferior oil. When thoroughly cleaned, the kernels are ground, usually by a system of corrugated rolls which do not crush them as fine as cottonseed is ground in this country.

The ground material is then pressed in what is known as the Marseille press. This is somewhat similar to the ordinary fruit or cider press used in this country, but more powerful. It consists of a piston carrying a platform upon which the square cheeses (meal wrapped in press cloth) are laid, one at a time, each successive cake being separated from the one below it by a thin steel plate. These presses have no protecting sides, or "boxes," such as are usually found in the American hydraulic presses, and the pressure which is applied to the peanuts is much less than that used with cottonseed. When the press is full, the pressure is applied and the material allowed to stand under pressure until a little over half of the oil has been squeezed out. This gives what is known as cold-drawn oil, which is nearly colorless, has a pleasant, nutty taste, and needs no refining to make it suitable for salad or cooking purposes, provided, of course, the original peanut material was clean and free from rancid nuts.

After the first pressing the cakes are taken out of the cloths, reground, and sometimes a small quantity of moisture is added. After being heated for a few minutes new cakes are formed and again pressed. The oil thus obtained is of a quality inferior to that from the first pressing and goes into a low-grade edible oil or prime soap oil. A third pressing usually is made, and in some mills a fourth, before the cake has been exhausted. Both of these pressings are made after regrinding and heating the cake. There is usually about 6 per cent of oil left in the final cake, which according to Bolton and Revis[1] has the following average composition:

	Per cent.		Per cent.
Moisture	10.68	Digestible carbohydrates	30.49
Oil	5.8	Mineral matter	4.06
Woody fiber	3.85		
Albuminoids	45.12		

For edible purposes the European market requires a very light colored oil, and to obtain this it is usually necessary to filter it through

[1] Bolton, E. R., and Revis, Cecil. Fatty Foods, Their Practical Examination, p. 204. London [n. d.].

fuller's earth or charcoal. If the oil is to be used in making margarine this removal of color is not only unnecessary but undesirable.

Within the last few years rapid progress has been made abroad, especially in Marseille and Nice, in the refining and deodorizing of vegetable oils. According to Thompson,[1] in 1912 some 175,000 barrels of Coromandel peanut oil, which would formerly have been considered inedible, was, by refining, put into the edible class. As this oil often runs as high as 25 to 40 per cent of free fatty acid, the refining loss is very high.

In Europe, the very finest grades of peanut oil are used exclusively for edible purposes, and practically all that is produced in France is consumed at home, only second-grade oils being exported to the United States. Probably a large portion of the second-grade edible oil made in France, Germany, and Holland is used by these countries in the manufacture of vegetable margarines, which are mixtures of peanut, coconut, and similar oils ripened with milk. An additional quantity of peanut oil enters into the composition of oleomargarine—that is, margarines which contain animal fats. Since olive oil will not stand the high or continued heating required of oils used in the cooking of such products as sardines, peanut oil is generally used. After the fish have been cooked in the peanut oil, they are drained, put into cans, and the cans filled with olive oil. In addition to these three uses for edible peanut oil, large quantities of the low-grade or inedible oils go into the soap kettles of Europe.

In the United States the consumption of peanut oil as a salad oil for cooking, and in the making of oleomargarines and similar compounds could probably be greatly increased by placing a high-grade edible oil on the market at a price slightly lower than that received for the best brands of imported oil. At the present time there is no established market for a high-grade American-made peanut oil, because very little has been put on the market.

VARIETIES OF PEANUTS GROWN IN THE UNITED STATES.

There are five distinct varieties of peanuts grown in the United States—Spanish, Virginia Bunch, Virginia Runner, Valencia (or Tennessee Red), and African (or North Carolina). While any of these could be used in the manufacture of peanut oil, the Spanish is the best one and is the only variety that should be grown for this purpose. The Spanish peanut is adapted to a wider range of soil and climatic conditions and contains a higher oil content than any other variety, with the possible exception of the Valencia.

[1] Thompson, E. W. Edible Oils in the Mediterranean District. U. S. Dept. Com., Bur. For. and Dom. Com., Spec. Agent Ser. no. 75, p. 8. 1913.

The following descriptions of varieties may be of interest to those not familiar with them:

Spanish.—A small-podded variety with heavy foliage; stems upright; pods thin, usually well filled, clustered about the base of the plant and adhering well in digging; peas rich in oil. This variety will mature in less time than any other and can be planted after a crop of early vegetables or after oats, wheat, or some other grain crop. The standard weight is 30 pounds per bushel.

Virginia Bunch.—A large-podded variety with rather light foliage; stems upright; pods clustered about the base of the plant. The customary weight per bushel is 22 pounds. As this variety has a lower oil content and a smaller proportion of meats to shell than the Spanish, it should not be grown for oil purposes.

Virginia Runner.—A large-podded variety with heavy foliage; stems creeping; pods scattered along procumbent stems and not adhering well in digging; pods and peas similar to those of the Virginia Bunch peanut. This variety is harder to cure than the bunch types, because the pods are scattered along the stems and can not be as well protected from the weather as the varieties with nuts clustered near the base of the plant. The weight per bushel is 22 pounds.

Valencia.—A small-podded variety with heavy foliage; stems upright; pods long, usually containing three or four peas, but sometimes as many as five or six; peas dull red, darker in color than the Spanish. This variety is a rather heavy yielder, but the pods pull off badly in digging. It is not grown to any great extent in this country.

African (or North Carolina).—A small-podded variety with very heavy dark-green foliage; stems creeping, sometimes having a spread of 3 or 4 feet; pods scattered along procumbent stems and not adhering well in digging; small, a little larger than the Spanish variety, usually containing two peas. As the African peanut produces a larger percentage of "pops," or poorly filled pods, than any other variety and requires a longer growing season, it should not be generally grown.

The Spanish peanut contains a larger proportion of meats to hulls than any other variety. In a shelling test made by the United States Department of Agriculture, farmers' stock Spanish peanuts shelled out 78.70 per cent, the Virginia Bunch 71.15, and the African 71.45 per cent. In this test the trash and dirt usually found in farmers' stock peanuts were not considered. Clean peanuts were selected from an average sample as they are received at cleaning and shelling plants. They were shelled by hand and the meats and hulls were weighed separately. In a commercial shelling plant the percentage of meats secured would probably be at least 10 per cent less than was found in this test, because of the dirt, trash, and "pops," or poorly filled pods; in fact, cleaners are satisfied if they secure 66 to 70 per cent of meats from farmers' stock Spanish peanuts and about 60 per cent for the Virginia type. Shelled Spanish peanuts contain 5 to 10 per cent more oil than the Virginia Bunch and Virginia Runner varieties. The oil content, taken in connection with the difference in the weight per bushel, the habit of growth, quicker maturity, etc., shows that the Spanish is much more valuable for oil production than any other variety of peanut grown in the United States.

In addition to peanuts grown especially for oil purposes, large quantities of low-grade nuts which accumulate at cleaning factories could be used to advantage in making a soap oil or for other industrial purposes. Using this grade of nuts for making oil would serve to increase the price for the better grade nuts, as the low grades would be removed from competition with the high-grade product. Some of the oil mills of the South have been buying low-grade shelled nuts from cleaning and shelling factories and using them for manufacturing peanut oil. The cleaners can afford to sell this product at a low price to oil mills, as food manufacturers are then forced to buy a better grade product for their use. The selling of No. 2 and No. 3 shelled nuts to oil mills recently has raised the price of No. 1 shelled nuts and also of good farmers' stock peanuts.

THE PREPARATION OF PEANUTS FOR OIL MAKING.

Where the very highest grade edible oil is desired, it may be necessary thoroughly to clean, shell, blanch, and degerm the peanuts. Peanuts as received from the farmers usually contain considerable dirt, sticks, and trash of various kinds. These materials must be removed by screens, fans, or suction blasts, such as are used in cleaning and shelling establishments, whether the nuts are to be pressed before or after shelling. Peanuts are usually shelled by machines made especially for this purpose. It is possible that the cottonseed huller can be used for shelling peanuts, but the machine would have to be so adjusted as to give greater clearance space for the peas, to prevent breaking them, and run at a slower speed than for cottonseed. After the nuts are shelled, the peas are separated from the hulls by means of a fan or suction blast. In the regular shellers the hulls and chaff are separated from the meats by suction as they fall from the sheller. This separation could be made in the same manner as they fall from the cottonseed huller.

In order to get the peanut kernels entirely free from trash and bad nuts, it is necessary to hand-pick them. In the cleaning and shelling plants this is done by passing them over a "picking table," alongside of which are seated a number of women, who pick out foreign matter and decayed nuts as the peanuts pass on a slowly moving belt. The cost of this hand picking usually does not exceed $1 per ton of farmers' stock. The hand picking would not be necessary except for a high-grade oil.

The blanching process consists in removing the red skin. The same operation usually separates the pea or kernel into halves and removes the germ, or heart. Blanching is accomplished by means of blanching machines, consisting of a set of brushes revolving against a corrugated plate. The meats are separated from the chaff and germs by passing them over screens and in front of a fan. The skins are blown out

and the germs fall through the screen, which should have round holes seven thirty-seconds of an inch in diameter. It is not feasible to remove all of the red skin, but as much as possible should be removed. The germs should also be removed, as the oil in them is of a lower quality than that in the remainder of the nut.

When using a hydraulic press for expressing peanut oil it is necessary to grind the peanuts and run the ground material through rolls to crush the oil cells. The grinding and rolling, or crushing, can be accomplished by using the grinders and rolls now used in cotton-oil mills.

When using a continuous working machine of the expeller type it is not necessary to grind the material, although the cake would have to be ground for the second pressing.

As the germs are quite rich in oil and the skins contain about 14 per cent, these products should not be wasted. They can be used advantageously in the manufacture of low-grade oils, which can later be refined in a manner similar to crude cottonseed oil or used in making soap. Some of the manufacturers of peanut butter and other peanut products are now selling to oil mills for a good price the germs and seed coats, or skins, which are waste in their plants.

MACHINERY FOR MANUFACTURING PEANUT OIL.

In the manufacture of peanut oil in a cottonseed-oil mill it would be necessary to install additional machinery in order to make a high-grade oil. The oil presses, grinders, filter presses, and conveyors in use in cotton-oil mills can be used for making peanut oil. In addition to these machines, it would be advisable to install equipment that is used in peanut cleaning and shelling factories. This equipment consists of cleaning, shelling, and blanching machines and the necessary conveyors, fans, sieves, etc. Dealers in peanut cleaning and shelling machinery can probably furnish all the equipment necessary in preparing peanuts for oil making.

It is probable that machinery made in this country for use in peanut cleaning and shelling plants would be more satisfactory than that used in Marseille. The peanut industry is much more highly developed in the United States than anywhere else in the world, and practically all the machinery used has been designed especially for this purpose.

ANALYSES OF AMERICAN-GROWN PEANUTS.

Unfortunately, the number of analyses of American-grown peanuts is small, but those given in the following tables are fairly representative. More analyses have been made of the Spanish and Virginia than of any other varieties, because they are the most important commercial types. Table I gives the analyses of 12 samples of Spanish and of 19 samples of Virginia peanuts.

TABLE I.—*Analyses of peanuts of the Spanish and Virginia varieties, as grown in the United States.*

Variety.	Source.	Constituents (per cent).			
		Moisture.	Oil.	Oil (dry basis).	Ash.
Spanish:					
Sample a		3.8	50.2	52.2	
Sample b		5.1	50.6	53.3	2.3
Sample c		2.7	52.8	54.3	2.4
Sample d		4.2	47.6	49.7	2.4
Sample e		2.6	49.4	50.7	2.4
Sample f		6.4	48.0	51.0	2.4
Sample g	Mississippi	3.2	50.1	51.8	
Sample h	North Carolina	3.3	48.2	49.8	
Sample i	District of Columbia	3.4	52.2	54.0	
Sample j		6.3	49.0	52.3	
Sample k		1.4	50.4	51.1	
Sample l	Louisiana	4.4	47.4	49.6	
Average		3.9	50.0	52.5	2.4
Virginia:					
Grade No. 1		3.5	43.0	44.5	
Grade No. 3		3.5	45.3	47.0	
Grade No. 1		5.4	41.1	43.5	
Grade No. 2		6.2	38.1	40.6	
Grade Splits		3.4	46.4	48.0	
Grade No. 1		5.1	40.1	42.3	2.0
Do		.5	48.3	48.5	2.0
Do		.6	47.2	47.4	2.1
Grade No. 2		6.3	44.3	46.6	2.3
Do		2.5	45.1	46.2	2.1
Do		1.7	45.2	45.9	2.7
Grade No. 3		7.1	43.8	44.2	3.9
Do		4.0	35.9	37.4	4.4
Do		3.5	35.2	36.5	3.2
Do		6.3	29.8	31.6	
Do		4.7	36.5	38.3	
Farmers' stock		4.1	37.2	38.8	
Do		3.6	45.7	47.4	
Do		4.7	40.0	42.0	
Average		4.1	41.7	43.3	2.7

It will be noticed that the average percentage of oil for the 12 samples of Spanish peanuts is 52.5 and of the 19 samples of the Virginia variety, 43.3, figured on the basis of dry shelled nuts.

As has already been stated, the weight of shells and trash per ton of farmers' stock is about 600 pounds, so that the average amount of oil in a ton of unshelled Spanish peanuts, figured on the basis of 50 per cent of oil, is approximately 700 pounds. Similarly, for Virginia peanuts, which have an average oil content of 42 per cent in the shelled goods and run about 800 pounds of shells and trash to the ton of farmers' stock, there are 500 pounds of oil per ton. The amount of oil present in the average sample of farmers' stock peanuts as received at the mill will usually be slightly less than this, due to the higher moisture content in the raw material.

Assuming that the residual cake will contain 9 per cent of oil, the theoretical yield would be 630 pounds of oil per ton of farmers' stock Spanish and 430 pounds of oil per ton of Virginia peanuts. The laboratory experiments carried on over a series of years by the United States Department of Agriculture, in which peanuts from various sections of the country were pressed in a half-size expeller,

indicate that under ideal conditions it is possible to obtain in a single pressing a cake which has as low as 6 per cent of oil, and in one or two instances it has been possible to obtain by a second pressing cakes containing less than 5 per cent. These results apply to both peanuts pressed in the shell and shelled goods. On a larger scale, however, it will probably be impracticable and doubtless undesirable to work for such high yields. The tonnage capacity of the continuous press decreases rapidly when attempts are made to obtain a cake with less than 8 or 9 per cent, and the increased labor and power cost would thus more than offset the increased value of the oil recovered. Laboratory experiments with the continuous press or expeller could not be paralleled with similar runs on a hydraulic press, and the only data available are those obtained from analyses of a few isolated samples of cake. These were obtained from cotton-oil mills, where the peanuts were pressed in their regular hydraulic presses. The oil content of these cakes varies between 7 and 9 per cent.

Analyses of the shelled nuts and of the shells of the five standard varieties of peanuts grown on the same soil at Florence, S. C., in 1915 are given in Table II. These peanuts were grown and analyzed by the department. So far as the writers have been able to learn, these analyses are the only ones ever made of the five types of peanuts grown under identical conditions.

TABLE II.—*Analyses of five varieties of peanuts grown at Florence, S. C.*

Variety.	Constituents of shelled nuts (per cent).					Constituents of shells (per cent).				
	Moisture.	Oil.	Crude fiber.	Protein.	Ash.	Moisture.	Oil.	Crude fiber.	Protein.	Ash.
Virginia Runner	3.35	46.58	2.73	29.60	2.76	5.23	0.73	78.28	5.07	4.11
Virginia Bunch	3.28	45.73	2.84	29.52	3.11	5.23	3.53	70.00	7.25	3.95
Spanish	3.30	49.10	2.30	31.20	2.67	5.03	3.20	66.70	8.16	6.81
Valencia	3.75	49.60	2.13	33.64	2.67	5.80	1.38	70.72	7.23	3.34
African	3.45	45.90	2.26	30.30	3.31	5.45	2.46	71.70	7.60	3.38

It will be noticed that there is very little difference between the oil content of the Valencia and the Spanish and that these two varieties are higher in oil than the other three. The Virginia Bunch, Virginia Runner, and African have nearly the same percentage of oil. The difference in oil content of the five varieties is not very great. In fact, there is as much difference in the percentage of oil in Spanish peanuts grown under different conditions as there is between the different varieties grown under the same conditions, as can be seen by comparing Tables I and II.

It will be noticed that the shells from Spanish peanuts contain less crude fiber and more protein and ash than any other variety. The shells of the Virginia Runner peanuts contain less oil and protein and more crude fiber than any other variety.

THE MANUFACTURE OF PEANUT OIL IN THE UNITED STATES.

To date, very little peanut oil has been manufactured in the United States, because peanuts have been disposed of in other channels of trade at a price higher than could be paid by oil manufacturers. However, on account of the present high price and scarcity of cottonseed several oil mills in the South are now making some peanut oil. If peanut oil is to be manufactured on a large scale in the United States the cotton-oil mills already established will naturally be the ones to go into the business. The experience and training of the cottonseed-oil manufacturers will be valuable in enabling them to solve the new problems which will arise in connection with the manufacture of peanut oil. The machinery in use in cottonseed-oil mills can be used, with a little adjustment and modification, for manufacturing peanut oil. Inasmuch at there are two general types of crude-oil mills now operating in the South, the hydraulic mill and the expeller or cold-press mill, the production of peanut oil may reasonably be expected to develop in both kinds of mills.

Experiments made on a large scale in cottonseed-oil mills in this country demonstrate that the ordinary box presses and press cloth, with practically no alteration, can be used in making peanut oil either from shelled or unshelled stock. The expeller type of press also has been used satisfactorily in a number of mills. Most of the oil mills manufacturing peanut oil have used the same methods of grinding, cooking, pressing, etc., that are used for cottonseed oil, but a first-grade oil can not be made from cooked material.

Where the hydraulic press is used for making a high-grade edible oil, it is necessary to clean, shell, blanch, and degerm the nuts, as already mentioned. Then the meats should be ground and rolled in such a way that the oil cells are crushed. The ground material should be pressed cold the first time, in order to produce a high-grade oil. After this first pressing the cake should be ground, heated, and again pressed, as described under the European method of making peanut oil. It will probably not be necessary to make more than two pressings in the American presses.

In a continuous working machine of the expeller type the peanuts should be treated as mentioned in the preceding paragraph, except that it is not necessary to grind the meats before feeding them into the machine. In the expeller mill there is some difficulty in getting a good yield from shelled nuts, and, as there is less heating of the raw material before pressing, the oil made from unshelled nuts does not have quite as much of the shell taste as is the case in the hydraulic press. Although, when working carefully on a small scale, very good oils have been made from thoroughly cleaned, unshelled nuts, it is very doubtful whether under commercial conditions a high-grade table oil can be produced without shelling and blanching the nuts.

The presence of a small quantity of shells in the continuous press helps to increase the capacity of the machine and reduces the amount of "foots" squeezing through the bars with the oil. It is possible, however, so to temper the blanched peas that a good cake, containing as low as 6 per cent of oil, can be produced, together with a fairly clear oil. If for any reason only a second-grade oil, which is to be refined or used for soap making without refining, is to be made, it would not be necessary to shell or grind the nuts before feeding to the expeller. The yield of oil and the capacity of the presses can be increased by grinding and tempering instead of feeding the unshelled nuts direct to the machine. In any case where the nuts are not shelled, the stock should be thoroughly cleaned, to remove dirt, stones, trash, etc., as these materials affect the quality of the oil and increase the wear and tear on the machines.

There are some fundamental differences between the peanut and cottonseed as an oil material. The proportion of hull to meat is less in the peanut than in cottonseed, and as the shell of the peanut is more absorbent than cottonseed hulls the loss of oil in pressing unshelled peanuts will be greater than with cottonseed. It is obvious that decortication can be accomplished much more readily with the peanut than with cottonseed.

The really important difference between these two seeds, however, is in the oil itself. Cottonseed oil belongs to that class of vegetable glycerids that have to be refined before they are edible, while peanut oil, if properly pressed from sound stock, has a good color, a sweet, nutty flavor, and is a thoroughly satisfactory table oil just as it runs from the press. There is, of course, more or less insoluble matter, fine particles of the peanut, which have to be taken out to prevent a rapid spoiling of the oil, but this is easily removed by filtering. In this respect peanut oil is like olive oil, the best grade of which appears on our tables just as it comes from the fruit; in fact, just as it existed in the olives themselves.

Old, rancid peanut oils, made from spoiled nuts or from sound nuts improperly treated, can be refined and the disagreeable odor and flavor removed, but such oils are lacking in the characteristic sweet peanut taste of a virgin oil and are inferior for salad and general table purposes. Doubtless the low-grade oils, made from rancid nuts or by a second hot pressing of the cake from which the first-grade oil has been removed, will find a market with the refiner. These, when properly treated, yield a bland oil entirely satisfactory for many purposes, but the loss due to refining and the lower price which such oils command make it desirable to produce as large a quantity as possible of high-grade oil which does not need to be refined. Just how much more a mill can afford to pay for good, fresh stock, how much can be spent in grading, sorting, and cleaning the stock, and what proportion

of it should be cold pressed and what hot pressed will depend upon the relative market price for the virgin and refined oils.

At the present time there is very little demand in the United States for a high-grade peanut oil, but many who have tried prime cold-pressed peanut oil for salads consider it equal, if not superior, to olive oil. The difference between these two is one of flavor, and just as one person prefers an apple to an orange, so some people will always prefer an oil with a very characteristic taste like olive oil, or a bland oil, such as refined cottonseed oil, to the mild, nutty flavor of peanut oil.

That peanut oils can be satisfactorily refined with as little loss, calculated on the free fatty acid content, as cottonseed oils is undoubtedly true, but that such refined oils will command as high a market price as the virgin oils seems very doubtful.

BY-PRODUCTS OF PEANUT-OIL MANUFACTURE.

The principal by-product of peanut-oil manufacture is the meal, which is a very valuable feed. One ton of farmers' stock Spanish peanuts will yield about 750 pounds of meal if the shelled nuts are used. This cake sells for $30 to $35 per ton. At $30 per ton the meal from a ton of farmers' stock Spanish peanuts would be worth $11.25. The meal is a very high grade feed and can be used for all classes of live stock without producing any ill effects. Peanut meal has about the same fertilizer value as cottonseed meal, but its greatest value is for live-stock feeding, and when so fed a large proportion of the fertilizing constituents can be returned to the land.

Where the peanuts are shelled before the oil is extracted the hulls may be classed as a by-product. They can be ground with the meal to give bulk, but they add very little to the food value. If not mixed with the feed, they can be used as fuel in the boilers which furnish power for running the mill or they can be sold for bedding for live stock.

ECONOMIC CONSIDERATIONS IN CONNECTION WITH THE MANUFACTURE OF PEANUT OIL.

Most of the peanut oil being manufactured in the United States at the present time is sold in competition with and at the same price as crude cottonseed oil. Because of the present high price of cottonseed oil it is possible to make peanut oil and sell it at the price of the former. If, however, the price of cottonseed oil returns to the level of the past five years and the cost of producing peanut oil remains at the current level, peanut oil could not compete with it at the lower price.

A bushel of good farmers' stock Spanish peanuts will yield about $1\frac{1}{8}$ to $1\frac{1}{4}$ gallons of oil, and this would have to sell for 60 cents a gallon to make a profit when 70 cents a bushel is paid for peanuts.

Farmers will not grow peanuts for market unless they feel reasonably sure that they will receive at least 70 cents per bushel, and at this price oil mills would have to put a high-grade oil on the market to make a profit under conditions when the competing product, cottonseed oil, sells at a lower level than at present. In other words, oil mills could not afford to pay 70 cents per bushel for peanuts to make an oil which would sell for 40 to 45 cents a gallon, which price, in recent years under more normal market condition, is considered high for cottonseed oil.

Before going into the production of peanuts for oil purposes, farmers should take into consideration the abnormal conditions prevailing at the present time (1916). Owners of oil mills are offering a price for peanuts that would justify farmers in growing them in 1916. If, however, cottonseed is plentiful and cheap next year the owners of oil mills very likely will not be willing to pay as much for peanuts as they are offering now. The peanut-growing industry should not be started in any section unless it is to be continued for a number of years, for growers will not be justified in buying the necessary machinery for handling the crop if the industry is to be dropped after one or two years.

YIELD OF PEANUTS, COST OF PRODUCTION, AND RETURNS.

While the average yield of Spanish peanuts is only about 35 bushels to the acre, any fairly successful farmer will produce 40 to 60 bushels. Yields of 75 to 100 bushels to the acre are not uncommon, and there are records of even higher yields.

The cost of growing an acre of peanuts varies considerably, depending upon the quantity of fertilizer used and the yield secured. The average cost is about $20 to $25 for a yield of 40 bushels per acre. The cost of production up to harvest time is practically the same for a low yield as for a high yield, but the cost of harvesting, thrashing, and handling is greater for a high yield.

On a 54-acre tract in northern Louisiana the average cost per acre was as follows:

Interest on investment	$8.00
Plowing and fitting land, seed, and planting	5.35
Cultivation	2.35
Harvesting and stacking	2.50
Cutting and hauling poles	1.37
Thrashing and hauling	4.80
Bags and twine	1.05
Total	25.42

The yield of this field was 60 bushels of nuts and 1 ton of hay per acre. The nuts sold for $1 a bushel and the hay for $12 a ton, making a gross return of $72 an acre. Deducting the cost of production,

which included the foreman's time, the grower received a net return of $46.58 per acre. At 70 cents per bushel for the nuts the returns would have been as follows:

60 bushels of peanuts, at 70 cents	$42.00
1 ton of hay	12.00
Gross return	54.00
Less cost of production	25.42
Net return	28.58

In most sections of the South, where the average yield of Spanish peanuts is about 35 bushels per acre, the estimated cost of production is as follows:

Interest on investment	$5.00
Plowing and fitting land	2.75
Seed and planting	2.75
Cultivation	2.50
Harvesting and stacking	3.75
Thrashing	3.00
Bags and twine	.75
Hauling	.75
Total	21.25

If the peanuts were sold for 70 cents a bushel and the hay at $12 a ton, the returns would be as follows:

35 bushels of peanuts, at 70 cents	$24.50
Two-thirds of a ton of hay, at $12 per ton	8.00
Gross return	32.50
Less cost of production	21.25
Net return	11.25

It should be borne in mind that the estimate of cost of production includes interest on investment and all labor charges as well as cost of materials. The estimated value of hay is quite low, as good peanut hay has practically the same feeding value as the best clover hay.

Experiments have shown that 1 ton of farmers' stock Spanish peanuts will yield about 600 pounds of dirt, hulls, and trash, 600 pounds (80 gallons) of oil, and 750 to 780 pounds of cake. The value of this oil will depend on its quality and upon the price of other oils. On the basis of 80 gallons of oil per ton of farmers' stock Spanish peanuts, this oil would have to sell for an average price of 60 to 65 cents a gallon in order to justify paying 70 cents per bushel for peanuts. At 60 cents a gallon the oil in a ton of nuts would be worth $48. The returns from a ton of farmers' stock Spanish peanuts used for oil purposes would be about as follows:

80 gallons of oil, at 60 cents	$48.00
750 pounds of meal, at $30 per ton	11.25
Total	59.25

At 70 cents per bushel a ton of Spanish peanuts would cost $46.66. This would leave $12.59 for the manufacturing and selling charges of the oil in 1 ton of farmers' stock Spanish peanuts.

Many of the mills now manufacturing peanut oil are securing only 60 to 65 gallons of oil from a ton of Spanish peanuts. The low yield of oil is to be accounted for by the low grade of nuts used, by not shelling the nuts before expressing the oil, and by the high percentage of oil left in the cake. With a yield of 65 gallons of oil, at the same price of 60 cents per gallon, the return per ton for oil and meal would be $50.25. There would be a difference between the cost and sale price of $3.59, which would not cover the cost of manufacture and distribution. As a matter of fact, peanuts crushed without shelling return 1,300 to 1,350 pounds of meal, instead of 750 pounds as from the shelled nuts. It should be noted, moreover, that meal made from unshelled nuts is much lower in protein content than that from shelled nuts.

THE PROPER LABELING OF PEANUT PRODUCTS.

In conclusion, a word as to the proper labeling of peanut oil and cake may be of interest to those who will market these products. Good peanut oil is a wholesome, palatable food, and no apologies should be made for its existence. It should be labeled and sold for just what it is and a demand created upon its own merits. The virgin grades, sweet and unrefined, should not be dressed up in foreign-looking labels or called simply salad oil. Call your product "American peanut oil," or, if you want to suggest a use for it, "peanut salad oil." The refined oil should be labeled "Refined peanut oil." The American Feed Control officials have tentatively taken the stand that the terms "peanut-oil cake" and "peanut-oil meal" can properly be applied only to the products made from shelled nuts and that when the unshelled peanuts are pressed the cake should be labeled: "Unhulled peanut oil feed" and the ingredients designated as "peanut meal and hulls." It would be a great mistake for the manufacturers of this valuable feed to lay themselves liable to embarrassing court proceedings because of the fact that a product containing a certain portion of shells was not properly labeled.

SUMMARY.

(1) Peanut oil is one of the most important of the world's food oils.

(2) The United States imported during the year ended June 30, 1914, 1,332,108 gallons of peanut oil, valued at $915,939.

(3) In making high-grade edible oils in Europe the peanuts are cleaned, shelled, blanched, and degermed before being pressed. The first pressing is made without heating the material. After the first pressing the cake is reground and heated for the second pressing. Three pressings are usually made, and in some mills a fourth.

(4) In Europe the best grades of peanut oil are used for edible purposes. The second-grade oil is used largely in the manufacture of margarines.

(5) Of the five varieties of peanuts grown in the United States, but one variety (the Spanish) should be grown for oil purposes.

(6) In order to make a very high grade edible oil the peanuts should be thoroughly cleaned, shelled, blanched, and degermed before being pressed.

(7) When using a hydraulic press for expressing peanut oil the cleaned meats are ground and rolled in order to crush the oil cells. In the expeller type of machine the grinding is not necessary.

(8) To make a high-grade peanut oil in a cottonseed-oil mill it will be necessary to install additional machinery. The equipment used in peanut cleaning and shelling factories could be used to advantage.

(9) Experiments made in cottonseed-oil mills in this country show that the presses now in use can be used for making peanut oil.

(10) The first pressing should be made cold, in order to get a high-grade edible oil which will not need refining. The second pressing should be made after regrinding and heating the cake from the first pressing. It is doubtful whether more than two pressings should be made in this country.

(11) The oil from the first pressing should be a high-grade edible oil. The oil from the second pressing might be refined and used for cooking or for the manufacture of oleomargarine, or it might be used without refining for soap making.

(12) The analyses of a large number of miscellaneous samples of Virginia and Spanish peanuts show a difference in favor of the latter of about 9 per cent in oil content. However, the analyses of the five varieties grown under the same conditions show very little difference in the percentage of oil.

(13) Peanut meal, a valuable by-product of oil manufacture, is a highly nutritious stock feed.

(14) Under present conditions oil mills can not afford to pay more than 70 cents per bushel for peanuts to be used in making oil. Under normal conditions they could not afford to pay as much as this unless a higher grade oil is made than is being made at the present time.

(15) The average cost of production of peanuts is $20 to $25 for a yield of 35 bushels per acre. At 70 cents a bushel for the peanuts and $12 a ton for the hay the gross returns would be $32.50.

(16) At 70 cents a bushel for Spanish peanuts the oil must sell for 60 to 65 cents per gallon in order to make a profit, figured on the basis of 80 gallons of oil per ton of peanuts.

(17) Peanut oil and peanut meal should be correctly labeled and advertised for just what they are.

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